* =mandatory field)

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- **Dataset_Info**:*
  - Dataset_ID*: WHOTS_158W_23N_Jun2007_Jun2008
  - **Submission_Dates**:*
    - Initial_Submission: 20100930 (YYYYMMDD)
    - Revised_Submission: (YYYYMMDD)
- **Cruise_Info**:*
  - **Experiment**:
    - Experiment_Name*:
    - **Cruise**:**( - )**
      - Cruise_ID: (EXPOCODE)
      - Section: (Leg)
      - **Geographical_Coverage**:*
        - Geographical_Region:
        - **Bounds**:
          - Westernmost_Longitude:
            Enter decimal fractions of degrees:
            or Degrees, Minutes, Seconds:
          - Easternmost_Longitude:
            Enter decimal fractions of degrees: -157.97 (+ = E, - = W)
            or Degrees, Minutes, Seconds:
          - Northernmost_Latitude:
            Enter decimal fractions of degrees:+22.67 (+ = E, - = W)
          - Southernmost_Latitude:
            Enter decimal fractions of degrees:
      - **Temporal_Coverage**:
        - Start_Date: 20070626 (YYYYMMDD)
        - End_Date: 20080605 (YYYYMMDD)
  - **Vessel**:* Mooring platform
    - Vessel_Name:
    - Vessel_ID:
    - Country:
    - Vessel_Owner:
- **Variables_Info**:*
  - **Variable**:
    - Variable_Name and Description*:
- $xCO_2$ SW (wet) (umol/mol) - Mole fraction of $CO_2$ in air in equilibrium with the seawater at sea surface temperature and measured humidity.
- CO2 SW QF – Quality Flag for $xCO_2$ SW (wet).
- $H_2O$ SW (mmol/mol) - Mole fraction of $H_2O$ in air from equilibrator .
- $xCO_2$ Air (wet) (umol/mol) - Mole fraction of $CO_2$ in air from airblock, 4 feet above the sea surface at measured humidity.
- CO2 Air QF – Quality Flag for $xCO_2$ Air (wet)
- $H_2O$ Air (mmol/mol) - Mole fraction of $H_2O$ in air from airblock, 4 feet above the sea surface.

- Licor Atm Pressure (hPa) – Atmospheric pressure at the airblock, 4 feet above the sea surface
- Licor Temp (C) – Temperature of the Infrared Licor 820 in degrees Celsius
- % $O_2$ - The percent oxygen of the surface seawater divided by the percent oxygen of the atmosphere at 4 feet above the sea surface. Disclaimer: The oxygen measurement is made in the equilibrated air. We have found that the oxygen does not come to complete equilibrium so any rapid changes in oxygen do not get properly captured using this system. Therefore, we tend to use the oxygen data only as a qualitative sense of the biology. It is not a quantitative measure.
- SST (C) - Sea Surface Temperature collected by WHOI/UOP. WHOI/UOP provide internally recorded SST data at 10 minute resolution. The sea surface temperature collected during the equilibration period is reported in this dataset. WHOI/UOP advises to check the WHOTS site at the time of use for the most accurate data available.
- Salinity - Sea Surface Salinity collected by WHOI/UOP. WHOI/UOP records conductivity data at 10 minute intervals and then computes hourly averaged salinity during post-processing. The salinity reported during the equilibration period is reported in this dataset. WHOI/UOP advises to check the WHOTS site at the time of use for the most accurate data available.
- $xCO_2$ SW (dry) (umol/mol) – Mole fraction of $CO_2$ in air in equilibrium with the seawater at sea surface temperature (dry air).
- $xCO_2$ Air (dry) (umol/mol) – Mole fraction of $CO_2$ in air at the airblock, 4 feet above the sea surface (dry air).
- $fCO_2$ SW (sat) uatm – Fugacity of $CO_2$ in air in equilibrium with the seawater at sea surface temperature (100% humidity). Since the measurements are taken at the sea surface, warming calculations are not necessary.
- $fCO_2$ Air (sat) uatm – Fugacity of $CO_2$ in air at the airblock, 4 feet above the sea surface (100% humidity).
- $dfCO_2$ – Difference of the fugacity of the $CO_2$ in seawater and the fugacity of the $CO_2$ in air ($fCO_2$ SW - $fCO_2$ Air).

- **Method_Description**:*
  - **Equilibrator_Design**:
    - Equilibrator_Type: (show pick list) Bubble Equilibrator
    - Equilibrator_Volume: (L) N/A
    - Water_Flow_Rate: (L/min) N/A
    - Headspace_Gas_Flow_Rate: (L/min) ~600 cc/min
    - Vented: (show pick list) Yes
  - Measurement_Method: Absolute, non-dispersive infrared (NDIR) gas analyzer
  - Manufacturer_of_Calibration_Gas: NOAA Earth System Research Laboratory (ESRL)
  - **$CO_2$_Sensors**:
    - **$CO_2$_Sensor**:
      - Manufacturer: Licor
      - Model: Environmental_Control: LI-820
      - Resolution: 0.01 ppm
      - Uncertainty: < 2.5% of reading with 14 cm bench (stated) <1.5 ppm determined in lab
      - $CO_2$_Sensor_Calibration: (For each calibration gas, document traceability to an internationally recognized scale, including date and place of last calibration. Include uncertainty of assigned value.)

        At the beginning of each sample, the instrument self-calibrates using a zero and high standard. The zero standard is generated by cycling a small amount of air through a soda lime chamber. The high standard is from a cylinder of calibrated standard reference gas, 469.81 umol/mol, from ESRL. ESRL

standards are traceable to WMO x93 scale with a stated reproducibility of 0.06 micromole/mole.

- **Other_Sensors**: Oxygen Sensor
  - Manufacturer: Maxtec
  - Model: Max-250
  - Resolution: 0.01 %
  - Uncert-ainty: ± 2.0% Full Scale over operating temperature range
    ± 1.0% Full Scale @ constant temperature and pressure
  - Calibration: (For each sensor of pressure, temperature, and salinity, document traceability to an internationally recognized scale, including date and place of last calibration.)
    Factory calibrated before purchase. Recalibrated to sea level atmospheric air every 7 days.

- **Other_Sensors**: Humidity Sensor
  - Manufacturer: Sensirion
  - Model: SHT71
  - Resolution: 0.01 %
  - Uncertainty: Measurement range: 0-100% RH
    Absolute. RH accuracy: +/- 3% RH (20-80% RH)
    Repeatability RH: +/- 0.1% RH
  - Calibration: (For each sensor of pressure, temperature, and salinity, document traceability to an internationally recognized scale, including date and place of last calibration.)
    Factory calibrated before purchase.

- Method_References: (Publication(s) describing method)

Sabine, C. (2005): High-resolution ocean and atmosphere $pCO_2$ time-series measurements. The State of the Ocean and the Ocean Observing System for Climate, Annual Report, Fiscal Year 2004, NOAA/OGP/Office of Climate Observation, Section 3.32a, 246–253.

- Additional Information

- All measurements are at sea surface temperature and atmospheric pressure.

- During the equilibration cycle, a closed loop of air equilibrates with seawater for 10 minutes. Once the equilibration period is complete, the pump stops and the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 hertz and then averaged.

- During the air cycle, fresh air is pumped through the detector for 1 minute. Once the pump stops, the system opens to the atmosphere allowing the pressure to equilibrate with atmospheric pressure. Measurements are recorded for 30 seconds at 2 hertz and then averaged.

- The gas streams for both the air cycle and equilibrator cycle are partially dried before entering the detector. The values listed as wet $xCO_2$ generally have relative humidity levels ranging from 40 to 80 percent. The humidity levels increase over the course of a deployment.

- Sampling occurs every 3 hours. The infrared detector is calibrated at the beginning of every sampling period. Averaged data and standard deviations for each measurement are transmitted back daily.

- To calculate the dry measurements, the water mole fraction in the Licor detector must be known. A relative humidity sensor is located immediately downstream of the detector.

- As part of the QC process, each data set is compared with the Marine Boundary Layer (MBL) data from GlobalView-$CO_2$. The data from this deployment, June 2007 to June 2008, were -4.2 ± 1.2 umol/mol on average of the MBL data and therefore a correction of +4 umol/mol was applied to the xCO2 (wet) data.

GLOBALVIEW-$CO_2$: Cooperative Atmospheric Data Integration Project - Carbon Dioxide. CD-ROM, NOAA ESRL, Boulder, Colorado [Also available on Internet via anonymous FTP to ftp.cmdl.noaa.gov, Path: ccg/co2/GLOBALVIEW], 2010

-During the QC process, an adjustment to the Licor pressure is also made based on each sensor's bias to barometric pressure as measured in the lab. For this system, the Licor pressure was adjusted by +0.8 kPa.

- No data = -9.999 or -999

- Data_set_References: (Publication(s) describing data set) None

- Citation: (How to cite this data set) Sabine, C. 2008. High-resolution ocean and atmosphere pCO2 time-series measurements from mooring WHOTS.
- **Data_Set_Link**:
  - URL*: http://www.pmel.noaa.gov/co2/moorings/hot/hot_main.htm
  - Label*:PMEL CO2 Group - WHOTS mooring
  - Link_Note: (Optional instructions or remarks)**(m s t)**

Quality Flags definitions:

2 = Acceptable measurement;
3 = Questionable measurement;
4 = Bad measurement
5 = Not reported;
9 = Sample not drown for this measurement from this bottle.

**Quality Flag Log for this dataset.**

| Date | Measurement | Value (Dry) | Flag | Comments |
|---|---|---|---|---|
| 7/16/2007 15:16 | xCO2_SW | 388.3438262 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 7/16/2007 15:16 | xCO2_Air | 384.5581456 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 8/16/2007 12:16 | xCO2_Air | 384.1436213 | 3 | CO2 air trend is off during this cycle |
| 8/28/2007 9:16 | xCO2_Air | 386.7907525 | 3 | CO2 air trend is off during this cycle |
| 10/13/2007 0:16 | xCO2_Air | 384.9999479 | 3 | CO2 air trend is off during this cycle |
| 11/2/2007 0:16 | xCO2_SW | 388.6778015 | 3 | CO2 data submitted was adjusted by - 4 ppm b/c span and zero calibration were off as predicted by change in Licor temperature |
| 11/2/2007 0:16 | xCO2_Air | 386.5110498 | 3 | CO2 data submitted was adjusted by - 4 ppm b/c span and zero calibration were off as predicted by change in Licor temperature |
| 11/8/2007 21:16 | xCO2_SW | 385.381566 | 3 | CO2 data submitted was adjusted by - 3 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 11/8/2007 21:16 | xCO2_Air | 385.9851362 | 3 | CO2 data submitted was adjusted by - 3 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 11/20/2007 21:16 | xCO2_SW | 379.4493904 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 11/20/2007 21:16 | xCO2_Air | 382.1269779 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |

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|---|---|---|---|---|
| 12/6/2007 0:16 | xCO2_SW | 396.2981467 | 3 | likely bad CO2 sw due to change in equil pump pressure |
| 12/17/2007 3:16 | xCO2_SW | 371.0647312 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/17/2007 3:16 | xCO2_Air | 384.6952486 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/18/2007 3:16 | xCO2_SW | 371.3261192 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/18/2007 3:16 | xCO2_Air | 385.2989105 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/25/2007 21:16 | xCO2_SW | 373.1907354 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/25/2007 21:16 | xCO2_Air | 385.688093 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/26/2007 3:16 | xCO2_SW | 372.4656957 | 3 | CO2 data submitted was adjusted by + 1 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/26/2007 3:16 | xCO2_Air | 385.8176378 | 3 | CO2 data submitted was adjusted by + 1 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/29/2007 9:16 | xCO2_SW | 373.9488442 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 12/29/2007 9:16 | xCO2_Air | 386.6108075 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/6/2008 3:16 | xCO2_SW | 371.5460668 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/6/2008 3:16 | xCO2_Air | 384.7282781 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/18/2008 9:16 | xCO2_SW | 360.1329263 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/18/2008 9:16 | xCO2_Air | 387.8908094 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/19/2008 15:16 | xCO2_SW | 362.1952382 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/19/2008 15:16 | xCO2_Air | 386.284229 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 1/26/2008 9:16 | xCO2_SW | 407.4203799 | 4 | bad CO2 sw due to change in equil pump pressure |
| 1/28/2008 6:16 | xCO2_SW | 361.7619675 | 4 | bad CO2 sw due to change in equil pump pressure |
| 1/29/2008 12:16 | xCO2_SW | 376.9925284 | 4 | bad CO2 sw due to change in equil pump pressure |
| 1/31/2008 18:16 | xCO2_Air | 394.4188896 | 3 | CO2 air trend is off during this cycle |
| 2/1/2008 3:16 | xCO2_SW | 364.7352581 | 4 | bad CO2 sw due to change in equil pump pressure |
| 2/2/2008 12:16 | xCO2_SW | 361.8479445 | 4 | bad CO2 sw due to change in equil pump pressure |
| 3/18/2008 9:16 | xCO2_SW | 363.5127113 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/18/2008 9:16 | xCO2_Air | 387.9771305 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/19/2008 0:16 | xCO2_SW | 364.5278166 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/19/2008 0:16 | xCO2_Air | 388.2109356 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/24/2008 6:16 | xCO2_SW | 366.0599754 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/24/2008 6:16 | xCO2_Air | 388.3406888 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/26/2008 15:16 | xCO2_SW | 364.1629787 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/26/2008 15:16 | xCO2_Air | 385.9587773 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 3/29/2008 18:16 | xCO2_SW | 363.9924067 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |

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|---|---|---|---|---|
| 3/29/2008 18:16 | xCO2_Air | 387.7005209 | 3 | CO2 data submitted was adjusted by - 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 4/2/2008 9:16 | xCO2_SW | 363.4205155 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 4/2/2008 9:16 | xCO2_Air | 385.7542703 | 3 | CO2 data submitted was adjusted by + 2 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 5/19/2008 3:16 | xCO2_SW | 394.673542 | 3 | CO2 data submitted was adjusted by + 18 ppm b/c span calibration was off as predicted by change in Licor temperature |
| 5/19/2008 3:16 | xCO2_Air | 388.7908059 | 3 | CO2 data submitted was adjusted by + 18 ppm b/c span calibration was off as predicted by change in Licor temperature |